

WE CLAIM:

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1. A wire bonding method, comprising the steps of:
forming a semiconductor substrate with a copper (Cu) interconnect material;
fabricating a copper (Cu) bond pad;
depositing a tantalum (Ta) layer onto the substrate;
patterning and etching the tantalum (Ta) layer; and
bonding an aluminum (Al) wire with the tantalum (Ta) layer;
wherein a portion of the tantalum (Ta) layer bonds with the copper (Cu) bond pad, and another portion of the tantalum (Ta) layer forms a tantalum aluminide ($TaAl_3$) compound.

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2. The method of claim 1, wherein the wire is a wire selected from the group consisting of an aluminum wire, an aluminum alloy wire, and an aluminum-coated gold wire.

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3. The method of claim 1, wherein thickness of the tantalum (Ta) layer is controlled such that a portion of the tantalum (Ta) layer bonds with the copper (Cu) bond pad, and another portion of the tantalum (Ta) layer

4 forms a tantalum aluminide ($TaAl_3$) compound.

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1 4. The method of claim 1, wherein thickness of the tantalum (Ta) layer is
2 between 300 to 1000 angstroms (\AA).

1 5. The method of claim 1, wherein the aluminum (Al) wire is bonded onto
2 the tantalum (Ta) layer by wedge bonding.

1 6. The method of claim 1, further comprising the step of performing a heat
2 treatment after the bonding step.

1 7. The method of claim 1, further comprising the step of packaging the
2 substrate in a package consisting of a plastic package and a hermetic
3 package.

1 8. The method of claim 1, wherein the tantalum (Ta) layer is patterned by
2 a method consisting of negative tone pad masking, photoresist
3 patterning, and photolithography.

1 9. The method of claim 1, wherein the substrate is a multi-layered

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interconnect structure.

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10. A wire bonding method, comprising the steps of:

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forming a passivation layer on a semiconductor substrate;

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bonding a wire onto the passivation layer; and

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encapsulating a bond pad made from an interconnect material, wherein

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the wire is more metallurgically stable than the interconnect material;

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wherein a portion of the passivation layer forms a metallurgical bond with

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the interconnect material;

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wherein a mechanical and electrical connection is provided between the

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interconnect material and the wire, with the passivation layer disposed

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therebetween.

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11. The method of claim 10, wherein the wire is a wire selected from the

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group consisting of an aluminum wire, an aluminum alloy wire, and an

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aluminum-coated gold wire.

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12. The method of claim 10, wherein the passivation layer is a tantalum (Ta)

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layer.

13. The method of claim 10, wherein the wire is bonded onto the passivation layer by wedge bonding.

14. The method of claim 10, further comprising the step of performing a heat treatment after the bonding step.

15. The method of claim 10, wherein the substrate is a multi-layered interconnect structure.

16. A semiconductor device, comprising:
a substrate;
a copper (Cu) bond pad formed on the substrate;
a tantalum (Ta) layer encapsulating the copper (Cu) bond pad;
wherein a portion of the tantalum (Ta) layer bonds with the copper (Cu) bond pad, and another portion of the tantalum (Ta) layer forms a tantalum aluminide (TaAl_3) compound.

17. The device of claim 16, wherein the substrate is a multi-layered interconnect structure.

1 18. The device of claim 16, wherein the tantalum (Ta) layer is bonded with
2 the copper (Cu) bond pad using wedge bonding.

1 19. The device of claim 16, wherein the substrate is packaged in one of the
2 group consisting of a plastic package and a hermetic package.

1 20. The device of claim 16, wherein thickness of the tantalum (Ta) layer is
2 between 300 to 1000 angstroms (Å).